# CERTIFICATE OF VERIFICATION

I, Su Hyun LEE of 648-23 Yeoksam-dong, Kangnam-ku, Seoul, Korea state that the attached document is a true and complete translation to the best of my knowledge of the Korean-English language and that the writings contained in the following pages are correct English translations of the specifications and claims of the Korean Patent Application No. P1998-43305.

Dated this 28th day of March 2005

Signature of translator: _____

Su Hyun LEE

## [ABSTRACT OF THE DISCLOSURE]


### [ABSTRACT]

A method of manufacturing a liquid crystal cell is disclosed, which comprises a step of forming a liquid crystal cell including two substrates, an alignment layer on at least one of the substrates, a sealant for sealing the two substrates, and a liquid crystal layer between the two substrates; a step of heating the liquid crystal cell; and a step of quickly cooling the liquid crystal cell.

[SPECIFICATION]

[TITLE OF THE INVENTION]

METHOD OF MANUFACTURING LIQUID CRYSTAL DISPLAY DEVICE

[BRIEF DESCRIPTION OF THE DRAWINGS]

FIG. 1 is a view showing liquid crystal molecules in the abnormal and normal regions of the alignment direction of the prior art.

FIG. 2 is a graph showing the transmittance T with respect to the driving voltage of the abnormal and normal regions A and B in the prior art.

FIG. 3 is a sectional view showing a liquid crystal display device manufactured according to the present invention.

FIG. 4 is a flowchart showing a manufacturing method of the liquid crystal display device according to the present invention.

FIG. 5 is a view showing liquid crystal molecules in the abnormal and normal regions of the alignment direction of the present invention.

FIG. 6 is a graph showing the transmittance T with respect to the driving voltage V of the abnormal and normal regions A and B in the present invention.

[DETAILED DESCRIPTION OF THE INVENTION]

[OBJECT OF THE INVENTION]

[FIELD OF THE INVENTION AND DISCUSSION OF THE RELATED ART]

The present invention relates to a liquid crystal display device (LCD), and more particularly, to a method of the liquid crystal display device that can prevent nonuniform illuminanance caused by a nonuniform alignment direction of an alignment layer.

A liquid crystal display device generally comprised an upper substrate, a lower substrate, a liquid crystal layer between the two substrates, and upper and lower alignment layer coated on inner surfaces of the two substrates. The alignment layer is generally imparted with an alignment direction by a rubbing process, and an initial alignment state of the liquid crystal layer is determined by the alignment direction.

However, after injecting the liquid crystal between the two substrates at a room temperature, the flow effect of the liquid crystal is memorized in the injected liquid crystal layer, changing the predetermined alignment direction.

Conventionally, in order to overcome this problem, an aging process is performed, wherein the liquid crystal is injected at a temperature higher than a nematic-isotropic transition temperature Tni (Tni: the transition temperature to the isotropic phase on the nematic, that is, the liquid crystal becomes transparent and isotropic when the liquid crystal is performed more than the nematic-isotropic transition temperature Tni). Generally, the aging process is performed at a temperature of 100℃.

If the liquid crystal is injected at a high temperature more than Tni, the liquid crystal molecules of the liquid crystal cell are in the isotropic phase since the nematic characteristics are removed from the liquid crystal. Then, the liquid crystal in the isotropic phase is slowly cooled at a room temperature, so that nucleation is initiated at liquid crystal molecules adjacent to the surface of the substrate, resulting in that the liquid crystal molecules are properly aligned according to the alignment direction.

On the other hand, when the alignment layer is dried and baked after coated on the substrate, a nonuniform pretilt angle of the alignment layer is caused by a nonuniform temperature. Furthermore, a nonuniform pretilt angle can be given locally to the alignment layer by a wrong rubbing process after the baking. In addition, the

alignment layer can be damaged by the injection of liquid crystal after the rubbing process, so that a localized nonuniformity of alignment direction is given to the alignment layer.

FIG. 1 is a view showing liquid crystal molecules 2 adjacent to the surface of the alignment layer 1, where A indicates an abnormal alignment region having an undesired alignment direction, and B indicates a normal alignment region having a desired alignment direction. As shown in this figure, the abnormal and normal alignment regions A and B have liquid crystal molecules aligned with different pretilt angles. Although the pretilt angles are overdrawn for easy explanation, the normal alignment region B generally has a pretilt angle in range of 4 to 5 degrees.

FIG. 2 is a graph showing the transmittance T with respect to the driving voltage V of the abnormal and normal regions A and B. This graph shows transmittance or illuminance difference X between the abnormal and normal regions A and B at a gray level voltage Vg. Because this localized nonuniform illuminance is caused by the nonuniform alignment direction of the alignment layer, it can not be solved by the conventional aging process.

Further, when there is an impurity in a pixel region of the alignment layer, abnormal alignment directions are caused by the impurity in its adjacent pixel regions as well as the pixel region. The abnormal alignment directions are resulted in point defect in display.

## [TECHNICAL TASKS TO BE ACHIEVED BY THE INVENTION]

Accordingly, the present invention is directed to a method of manufacturing a liquid crystal display device that substantially obviates one or more of the problems due

to limitations and disadvantages of the related art.

An object of the present invention is to provide a method of manufacturing a liquid crystal display device, to prevent the abnormal alignment direction which caused by a nonuniform alignment direction of an alignment layer or by an impurity.

To achieve the object, the present invention provides a method of manufacturing a liquid crystal display device which comprises a step of forming a liquid crystal cell which includes two substrates, an alignment layer on at least one of the substrates, a sealant for sealing the two substrate, and a liquid crystal layer between the two substrates; a step of heating the liquid crystal cell; and a step of quickly cooling the liquid crystal cell.

After completion of the liquid crystal cell, if the liquid crystal cell is heated at the high temperature, the pretilt angle of the alignment layer is lower in entire region. Accordingly, the nonuniform illuminance caused by the nonuniform alignment direction is prevented.

In the prior art, an impurity in the alignment layers cause abnormal alignment direction in its adjacent pixel regions as well as the pixel region. On the other hand, because the liquid crystal cell is heated at the baking temperature of the alignment layer in the present invention, the abnormal alignment directions caused by the impurity are repaired, removing the point defects in the pixel regions adjacent to the impurity.

**[PREFERRED EMBODIMENTS OF THE INVENTION]**

Referring to the drawings, a preferred embodiment of the present invention is described in detail as follows.

As shown in FIG. 3, a liquid crystal display device manufactured according to

the present invention comprises first and second substrates 11 and 12, first and second alignment layers 13 and 14 coated on inner surface of the first and second substrates 11 and 12, a liquid crystal layer 16 between the two substrates 11 and 12, and a sealant 15 for laminating the two substrates to each other.

FIG. 4 is a flowchart showing a manufacturing method of the liquid crystal display device according to the present invention. The manufacturing method is explained as follows referring to FIG. 3 and FIG. 4.

First, the first and second alignment layers 13 and 14 are formed by coating an alignment material such as polyimide on the first and second substrates 11 and 12 (S1).

Thereafter, the alignment layers are dried and baked, and then are performed with an alignment process such as rubbing (S2).

Then, the substrates 11 and 12 are printed with a sealant 15 such as epoxy (S3), and then the sealant is cured. Then, the substrates are laminated to each other (S4), and then liquid crystal is injected into a gap between the two substrates 11 and 12 (S5), to obtain a liquid crystal cell.

The liquid crystal cell is heated in an oven (S6), and is then quickly cooled (S7). When polyimide is used for the alignment layer, the heating process is performed at a temperature above 150℃ more than 30 minutes.

It is preferable that the heating process is performed at a temperature above the baking temperature of polyimide, namely more than 170℃, an hour. The sealant may be broken if the liquid crystal cell is heated at a temperature more than the curing temperature of the sealant. Therefore, it is preferable that the heating process is performed at a temperature less than the curing temperature. For example, when using a sealant whose curing temperature is more than 230℃, the liquid crystal cell is

preferable to be heated at a temperature close to and less than 230℃. When using a conventional sealant whose curing temperature is about 180℃, the liquid crystal cell is preferable to be heated at a temperature close to and less than 180℃.

When using a photo-alignment layer such as polysiloxane, and cellulose cinnamate, it is preferable that the liquid crystal cell is quickly cooled after the heating process at a temperature more than Tni plus 10℃, for example, at 100℃ when Tni is 90℃.

If the liquid crystal cell is heated at the baking temperature of the alignment layers 13 and 14, or more than Tni, the pretilt angle of the alignment layer is lower in entire region. It is to be noted that the pretilt angle is lowered in the normal alignment region D more than the abnormal alignment region C, as shown in FIG. 5, resulting in reduction of the difference of pretilt angle between the abnormal and normal alignment regions C and D. In this figure, reference numeral 18 indicates liquid crystal molecules adjacent to the alignment layers 13 and 14.

FIG. 6 is a graph showing the transmittance T with respect to the driving voltage V of the abnormal and normal regions A and B in the present invention. This graph shows that in comparison with the prior art, transmittance or illuminance difference Y is reduced between the abnormal and normal regions A and B at a grey level voltage Vg. Consequently, the nonuniform illuminance caused by the nonuniform alignment direction is prevented.

In the prior art, an impurity in the alignment layers cause abnormal alignment direction in its adjacent pixel regions as well as the pixel region. On the other hand, because the liquid crystal cell is heated at the baking temperature of the alignment layer in the present invention, the abnormal alignment directions caused by the impurity are

repaired, removing the point defects in the pixel regions adjacent to the impurity.

**[ADVANTAGES OF THE INVENTION]**

Accordingly, the method of manufacturing the liquid crystal display device according to the present invention has the following advantages.

In the method of manufacturing the liquid crystal display device according to the present invention, after completion of the liquid crystal cell, the liquid crystal cell is heated at the baking temperature of the alignment layer. Accordingly, it is possible to decrease the nonuniformity of the alignment direction in the alignment layer after heating the liquid crystal cell, thereby decreasing the abnormal alignment generated by the impurity. As a result, it is possible to decrease the nonuniform illuminance of the liquid crystal display device, generated by the nonuniform alignment.

It will be apparent to those skilled in the art that various modification and variations can be made without departing from the spirit or scope of the inventions. Thus, it is intended that the present invention covers the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

**What is claimed is:**

1. A method of manufacturing a liquid crystal display device, comprising the steps of:

forming a liquid crystal cell which comprises two substrates; an alignment layer on at least one of the substrates; a sealant for sealing the two substrates; and a liquid crystal layer between the two substrates;

heating the liquid crystal cell; and

quickly cooling the liquid crystal cell.

2. The method according to claim 1, wherein the heating step is performed at a temperature more than 100℃.

3. The method according to claim 1, wherein the heating step is performed at a temperature more than 150℃.

4. The method according to claim 1, wherein the heating step is performed at a temperature more than 170℃.

5. The method according to claim 1, wherein the alignment layer is made of polyimide.

6. The method according to claim 1, wherein the alignment layer is made of a photo-alignment material.

7. The method according to claim 6, wherein the photo-alignment layer includes one of polysiloxane and cellulose cinnamate.

FIG.1

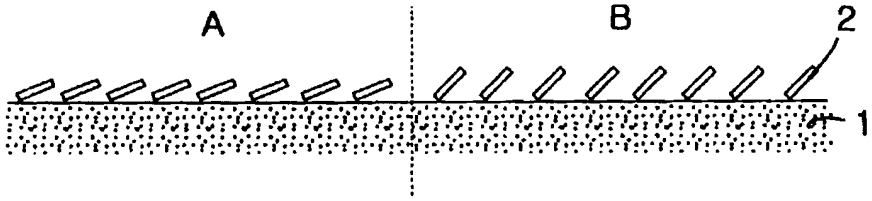


FIG.2

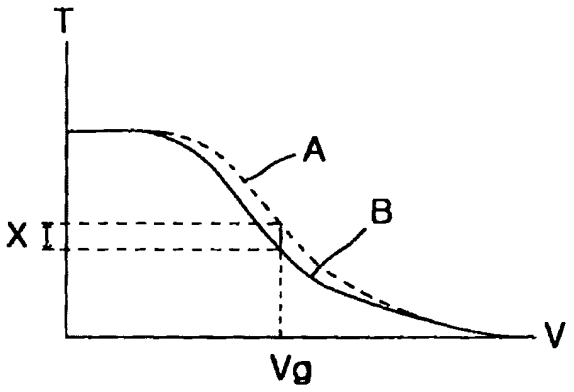

FIG.3

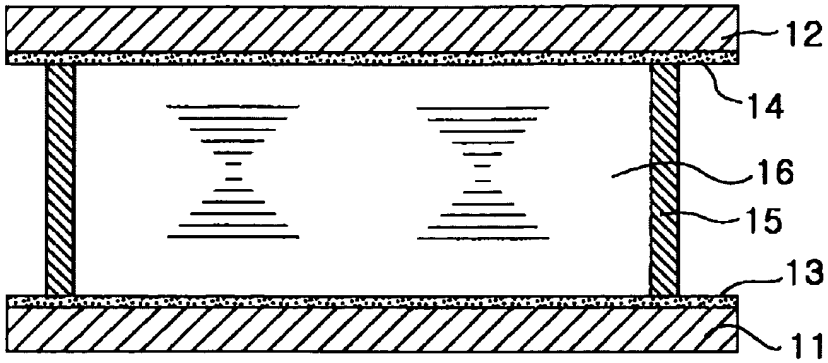

FIG.4

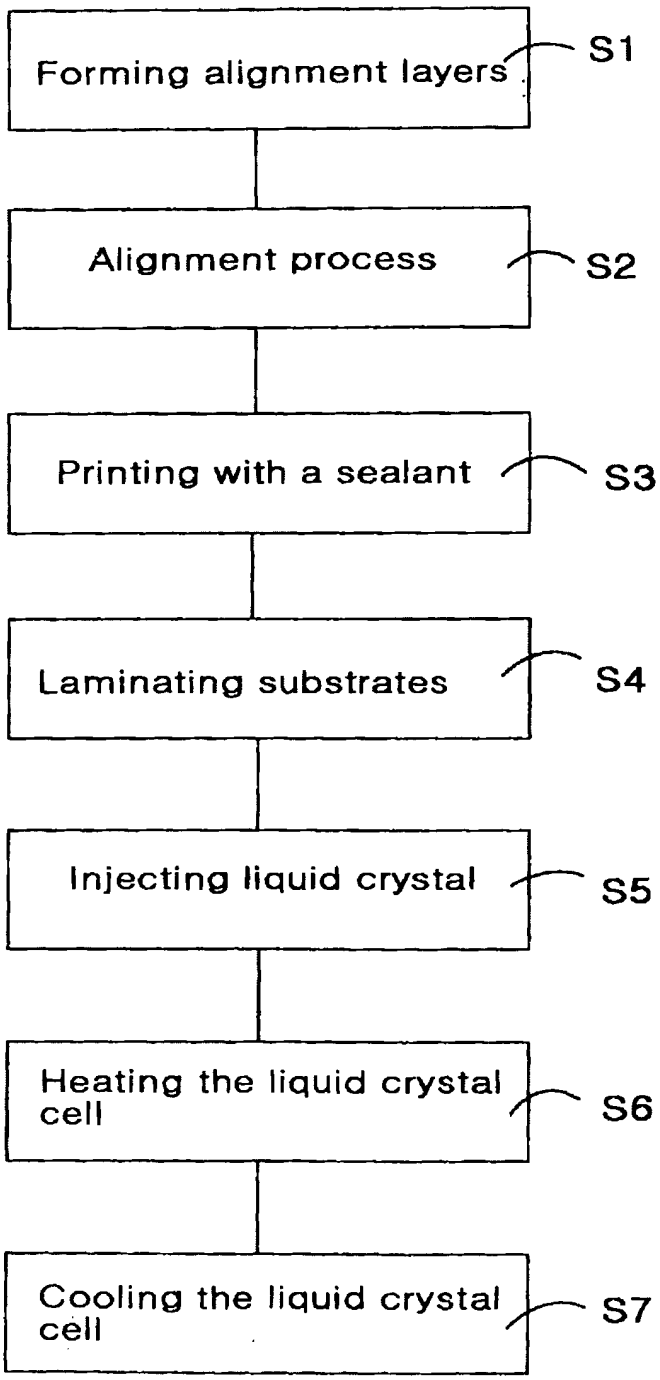

FIG.5

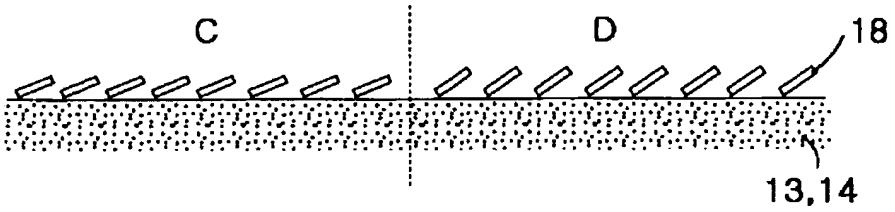


FIG.6